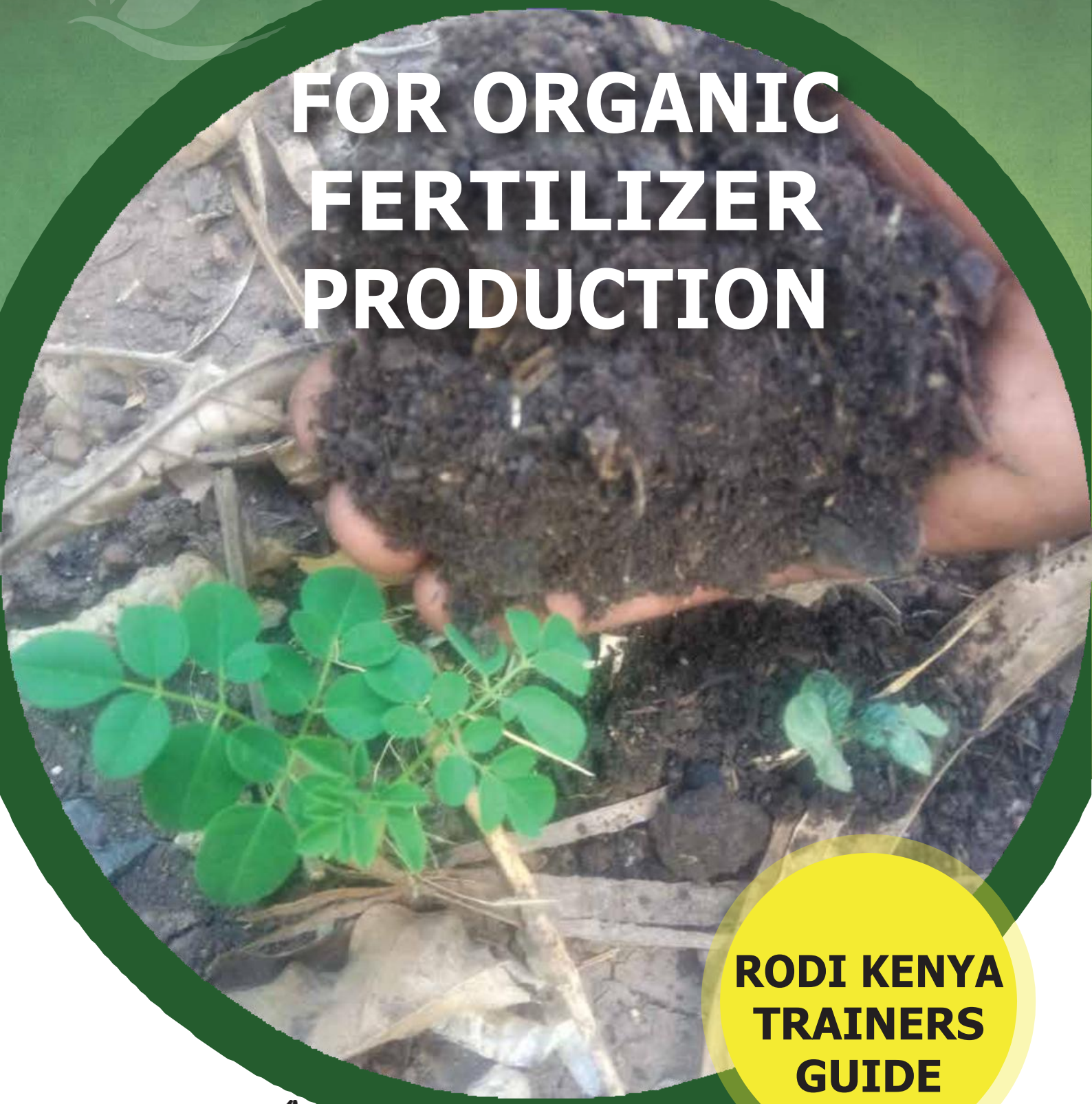
TRAINING MANUAL

FOR ORGANIC FERTILIZER PRODUCTION



RODI KENYA TRAINERS GUIDE

RODI Kenya

RESOURCES ORIENTED DEVELOPMENT INITIATIVES(RODI)

WATER and ENERGY for FOOD

This manual has been developed by RODI Kenya with the financial support of the German Federal Ministry for Economic Cooperation and Development (BMZ) and the European Union (EU), through the international initiative Water and Energy for Food (WE4F).
The manual was developed November 2023 in preparation for farmer trainings on organic fertilizer in different parts of Kenya.

INTRODUCTION:

The objectives of the training will be to enhance farmer's knowledge, skills and technologies in organic fertilizers to play an active role in enhancing food security, income generation and environment conservation for improved livelihood.

Training content:

1. Introduction to Organic Fertilizers: Understanding the principles, types, and benefits of organic fertilizers. (1hr)
2. Organic Fertilizer Production: Exploring methods for creating organic fertilizers from locally available resources - Bokashi, (2hr), Liquid Bio- fertilizer (1.5hrs)
3. Soil Health and Nutrient Management: Assessing soil quality and implementing effective nutrient management strategies. (30 Mins)
4. Application Techniques: Learning the best practices for applying organic fertilizers to maximize their efficacy. (30 Mins)
5. Environmental Considerations: Discussing the environmental impact of organic fertilizers and sustainable farming practices. (30 Mins)
6. Farm Integration: Integrating organic fertilizers into existing farming systems for improved yields and sustainability. (30Min)
7. Regulatory Compliance: Understanding local regulations and certifications related to organic farming inputs. (30 Mins)

CHAPTER 1: INTRODUCTION TO ORGANIC FERTILIZERS

The trainer will engage the farmers in group discussion; share case studies and posters on various forms of organic fertilizers with specific focus on.

- 4R principles for fertilizers (right type, amount, time and place)
- Soil testing as basis for fertilizer application
- Importance of soil acidity (pH) and lime application
- Types of fertilizer and effects on soil health, plant development and yields
- Types and benefits of organic fertilizers

The basic aim is to help target participants to understand the principles, types, and benefits of organic fertilizers.

A question to your participants: What are fertilizers?
A fertilizer is a chemical or natural substance added to the soil or land to increase its fertility.

Fertilizers are mainly classified into two main types: -

1. Organic fertilizers - are natural fertilizers derived from plants and animals such as organic compost, cattle manures, poultry droppings and domestic sewage.
2. Inorganic fertilizers - are manufactured products containing essential plant nutrients in chemical form with primary nutrients being, nitrogen (N), phosphorus (P), and potassium (K).

EFFECTS OF ORGANIC FERTILIZERS

Discuss with your participants the effects they have experienced while using organic fertilizers, have their yields improved? Are their soils healthy?

1. Effects on Soil Health:

- Organic fertilizers, such as compost and well-rotted manure, will improve soil structure by increasing its organic matter content. They will, over time, restore the soil.
- They provide a habitat and food source for beneficial soil microorganisms.
- Improved soil structure and organic matter content will help reduce soil erosion, making the soil more resilient to weather and water-related disturbances.

2. Effects on Plant Development:

- Organic fertilizers release nutrients slowly over time as they decompose providing a continuous supply of nutrients to plants.
- Organic fertilizers encourage root growth and development

3. Effects on Yields:

- Use of organic fertilizers leads to stable and consistent yields over time.
- Use of organic fertilizers leads to better flavour, texture, and nutritional content in fruits and vegetables.

EFFECTS OF INORGANIC (CHEMICAL) FERTILIZERS

Discuss with your participants the effects of inorganic fertilizers on soil health, plant development, and yields.

1. Effects on Soil Health

- They provide nutrients to plants quickly after application, which can be advantageous in situations where rapid nutrient correction is needed.
- High doses of inorganic fertilizers can inhibit soil microbial activity and reduce organic matter content in the long run, potentially affecting soil health negatively.

2. Effects on Plant Development:

- Rapid plant growth and development, especially in the case of nitrogen-based fertilizers.
- Overuse of inorganic fertilizers leads to nutrient imbalances, which may result in r educed crop quality or other issues like nutrient run-off.

3. Effects on Yields:

- Provide an immediate boost in crop yields when applied correctly.
- Over-reliance on chemical fertilizers can contribute to environmental issues like nutrient run-off into water bodies, which can harm aquatic ecosystems.

TYPES OF ORGANIC FERTILIZERS

The main practices to enhance soil fertility include the use of organic fertilizers such as:

1. Compost
2. Vermicompost
3. Green manures
4. Animal manure
5. Microbial fertilizers
6. Liquid manures/Bio-liquid fertilizers
7. Bio- fertilizers-solid

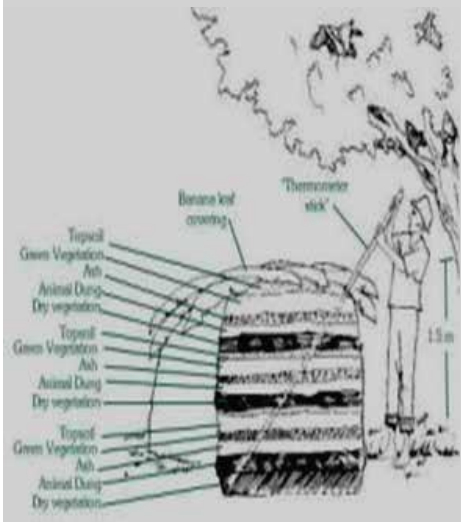
- Discuss with your participants the difference between the various forms of fertilizers.
- Ask your participants if they have used any of the organic fertilizers before, what is the process of making it, and what their experiences were.
- Ask your participants about the challenges they face while making each of the organic fertilizers and what they have done to deal with the challenges.

Pile/heap Compost

A compost heap should be built on bare soil and not on a hard surface such as concrete.

This is the recommended way to build a compost heap:

1. Firstly, make a base 30 centimeters (cm) high and 2 x 2 meters (m) wide with coarse plant material such as twigs. This will ensure good air circulation and drainage.
2. Add a 10 cm layer of material that is difficult to decompose such as maize stalks, twigs, or small branches.
3. Add a 10 cm layer of material that is easily decomposed such as fruit and vegetable scraps.
4. Add 2 cm of animal manure, old compost, or slurry, if available.
5. Add a sprinkling of earth from the top 10 cm of cropped land.
6. Ash and urine can then be lightly sprinkled onto these layers, to accelerate the process of decomposition.
7. Then water the whole pile well.
8. Repeat all these layers except the first layer of coarse material, until the heap reaches 1 to 1.5 m high.



Vermi-Compost:

Vermiculture is a process of breeding worms and the compost made out of such a process is vermicomposting.

Vermicomposting is the method where compost is prepared using specially introduced earthworms, Red Wigglers, as agents for decomposition.

- In contrast to ordinary composting, vermicomposting is mainly based on the activity of worms and does not go through a heating phase.
- Vermicomposting is a good technique for recycling food waste and crop residues from vegetable gardens in the proximity of the house.
- It creates small volumes of very rich manure. Though vermicompost is very good manure, it requires more investment (a tank and worms), attention, and more permanent care compared to ordinary composting.
- On the other hand, letting worms recycle farm or household waste saves time and labour input because no turning is required to keep the compost aerated.

Animal/Farmyard Manure

This is one of the common organic fertilizers used by most farmers who keep animals on their farms. Farmyard manure is made up of animal excreta(dung/poop) and bedding material (usually straw or grass)

Some characteristics and effects of farmyard manure: -

1. It contains large amounts of nutrients
2. The nitrogen in animal urine is available in the short term.
3. When dung and urine are mixed, they form a well-balanced source of nutrients for plants.
4. Organic manures contribute to the build-up of soil organic matter and thus improve soil fertility.

Green Manures:

Green manures are plants grown to accumulate nutrients for the main crop. When they have built up maximum nutrients, they are worked into the surface soil

Benefits of using green manure: -

1. They penetrate the soil with their roots making it more crumbly and easy to work on.
2. They suppress weeds and protect the soil from erosion and direct sunlight.
3. If legume plants are used, nitrogen is fixed from the air into the soil.
4. Some green manures can be used as fodder plants or even to provide food for human consumption
5. Green manures when decomposed release all kinds of nutrients in the correct mixture for the main crops to utilize thus improving their yield.
6. Green manure helps improve soil structure and water-holding capacity.

Benefits Of Organic Fertilizers

Ask your participants to mention the benefits they have encountered while using organic fertilizers:

1. They enhance oil structure by promoting the growth of beneficial micro-organisms and improving soil porosity (pore spaces), water retention, and aeration.
2. They release nutrients slowly as they break down, providing a consistent and sustained nutrient supply to plants.
3. They contain a spectrum of essential nutrients, which become readily available to plants as they decompose.
4. There is a reduced risk of over-fertilization since the nutrients are released slowly.
5. They promote the availability of micro-organisms in the soil that aid in improving soil health.
6. They improve soil fertility.
7. Plants and fruits have better taste.
8. It's easier to make the fertilizers at home.
9. It's cheap because you can make it yourself.

4R Principles for fertilizers:

Discuss with your participants the 4R principles for fertilizer management.
The 4R principles of fertilizer management are a set of best practices designed to optimize nutrient use in agriculture while minimizing environmental impacts.
Here's an overview of each of the 4R principles:

1. **Right Type:** This means applying the appropriate type of fertilizer for the soil type and crop grown.
2. **Right Rate:** This means applying the correct amount of fertilizer to fulfill the crop's needs, maintain soil fertility, and avoid wastage and pollution.
3. **Right Time:** This means the fertilizer must be available when the crop needs it.
4. **Right Place:** This means the fertilizer must be applied where crops can use it. Usually, this means in the root zone.

Now that your participants understand what the 4R principles are, ask them if they have been able to apply these principles.

Soil sampling and Testing:

Soil sampling is the process of taking a small quantity of soil from the field to act as a representative sample of the soil in that particular field.
Factors to consider in soil sampling

1. **Size of the land** - The larger the size of the land, the higher the number of samples to be collected.
2. **Cropping system** - This is the order in which crops are grown on a piece of land over a fixed period. For most soil tests the sampling depth is the tillage depth (six inches).
3. **Past management** - Fields used for the production of cultivated crops may be sampled any time after harvest or before planting when the land is dormant.
4. **Sampling tools** - Soil auger, panga, or a spade. Clean plastic bucket for collecting soil samples. Sampling bags - for packaging of soil samples for submission to the testing labs.

Discuss with your participants the importance of soil sampling.

1. Representative Results: By collecting samples from various locations within the field, you obtain a more comprehensive and representative assessment of soil properties.
2. Site-Specific Recommendations: Soil sampling allows for the customization of nutrient management recommendations.
3. Cost-Effective Nutrient Management: Sampling helps optimize nutrient management, preventing over-application or under-application of fertilizers.
4. Long-Term Soil Health: Regular soil sampling allows farmers to monitor changes in soil properties and nutrient levels over time.

Soil testing is a scientific process used to analyze the composition, quality, and characteristics of soil. Soil testing is a three-step process:

1. Nutrient extraction from the soil sample and analysis;
2. Interpretation of test results; and
3. Nutrient recommendations and crop advisory.

It provides valuable information about the soil's physical, chemical, and biological properties, which is crucial for various applications. For soil testing to be done, the soil must first be sampled from the farm or the field.

The main objectives of soil testing are:

1. To assess the soil fertility status and recommend suitable and economic nutrient doses through fertilizers or manure for different crops and cropping systems.
2. To identify the type and degree of degradation problems or abnormalities like soil acidity, salinity, toxicity, and sodicity and to propose effective measures to fix them.
3. To make continuous improvements in soil and plant tissue analysis.
4. Create a long-term plan to restore your soil and be less dependent on external inputs.
5. Advisory on what to plant on which soil.

SOIL TESTING CENTERS IN KENYA CONTACTS

f. Kenya Agricultural & Livestock Research Organization (KALRO), Nairobi: Tel: +254-722-206-986/+254-733-333-223, Email: info@kalro.org
2. MEA Fertilizer, Nairobi, Nakuru: Tel: +254-724-253-3f2/ +254-735-440-267, Email: info@mea.co.ke
3. Jomo Kenyatta University of Agriculture & Technology (JKUAT), Nairobi: Tel:+254-067-587000f, Email: info@jkuat.ac.ke
4. University of Nairobi, Nairobi: Tel: +254-020-33f8-262/ +254-020-2429-997: Email: pr@uonbi.ac.ke
5. Agrocares/Soil Care, Nairobi: Tel: +254-728-970-f36/ +254-706-5ff-f49: Email: info@agrocares.com | africa@agrocares.com
6. Crop Nutrition Laboratory Services Limited (Cropnuts): Kenya, Limuru +254-7ff-094-444 Email: support@cropnuts.com
7. Fadhili Africa Limited, Thika. TEL: +254-72f-5f9-576, +254-20-2638-485, Email: info@fadhiliafrica.com
8. Ujuzi Kilimo Ujuzi Kilimo, Nairobi - Muthaiga. TEL: +254-20-26ff-248. Email: info@ujuzikilimo.com
9. Coffee Research Institute: (CRI)

Ask your participants whether they understand what soil texture is and if this is the method they use to determine the various types of soil.

Soil texture is how the soil feels. It is often referred to as particle size.
Why is soil texture important in soil testing?
Soil texture is critically important in soil testing for several reasons.

1. For nutrient retention and availability.
2. Irrigation and Water Management: Farmers need to know soil texture to make informed decisions about irrigation scheduling and practices.
3. Crop Selection: Different crops have varying soil texture preferences. Some crops are better suited to specific soil textures.
4. Soil Amendments: Sandy soils may benefit from the addition of organic matter or compost to enhance water-holding capacity and nutrient retention.
5. Soil Testing Interpretation: Soil testing laboratories use soil texture information to interpret nutrient levels and provide fertilizer recommendations.
6. Tillage and Compaction Management: Farmers consider soil texture when choosing appropriate tillage practices.
7. Root Development and Penetration: Root growth can be limited in sandy soils due to poor water and nutrient retention.

With experience, it is possible to determine the soil texture by feeling it between the thumb and the first finger when it is wet. Another way could be the Jar Test, which is easily done without any big equipment (only a jar and a ruler).

Discuss this with your participants and let them share their thoughts on how soil structure affects soil structure.

Soil structure refers to the arrangement of soil particles with the resultant formation of big and small pores between soil particles.
Why is soil structure important in soil testing?

1. Root Development: Well-structured soils with good tillage and particles provide a favorable environment for roots to penetrate, explore, and access water and nutrients.
2. Water Absorption and Retention: Well-structured soils allow water to be absorbed easily, reducing runoff and preventing waterlogging.
3. Aeration and Gas Exchange: Properly structured soils allow for the even distribution of nutrients, ensuring that plant roots have access to essential elements.
4. Nutrient Distribution: Soils with well-formed particles are less prone to wind and water erosion, protecting topsoil and preventing soil loss.
5. Soil Erosion Resistance: Soils with well-formed particles are less prone to wind and water erosion, protecting topsoil and preventing soil loss.
6. Tillage and Compaction Management: Farmers choose tillage practices that maintain or improve soil structure while preventing compaction.
7. Soil Testing Interpretation: Soil testing laboratories consider soil structure when interpreting nutrient levels and making fertilizer recommendations.
8. Crop Performance: Crops generally perform better in soils with good structure, where roots can grow freely, water is well-managed, and nutrients are readily available.

Soil pH

Engage your participants on what soil pH is, is it a term they have heard before?
PH in full stands for Potential Hydrogen.

Soil pH is a measure of the relative acidity or alkalinity in soils. A solution with a pH less than 7 is considered acid; a solution with a pH greater than 7 is considered basic, or alkaline.

Engage your participants and let them share their thoughts or experiences about what they do to their soil when it's acidic.
The common method for managing acidic soils is through **liming.**

Liming

Refers to the practice of adding lime material to acidic soils to increase soil pH and maintain a favorable soil environment for plant growth.

Lime application under field conditions

How is lime applied in the field?

- Lime reacts with soil only when there is adequate soil-lime contact and moisture.
- The period should be at least 3 to 6 weeks before planting to give a good lime reaction.
- Liming acid soils is usually required every 3 to 5 years, depending on several factors such as management, rainfall, soil characteristics, etc.
- If applied too near the planting time, it can induce a temporary potassium deficiency because of the high calcium availability.

Ask your participants for some examples of the liming materials they have used to treat acidity in soil.

Commonly used materials for liming acid soils include calcium carbonate, calcitic limestone, dolomitic limestone, calcium hydroxide, calcium oxide, etc.

The benefits of liming include:

- Improves soil's physical and chemical conditions
- Increases root multiplication and promotes above-ground crop growth to improve nutrient and water uptake
- Calcium is an important constituent of cell wall material, adding strength and stability to the plant. Calcium deficiency causes stunted growth.

Other benefits of liming include:

1. Reduces certain acid-loving weeds such as stinging nettle.
2. Increases earthworm activity and improvement in soil structure, and grass is more palatable to livestock.
3. Fertilizer efficiency is improved when agricultural lime is added to acid soils. Liming acid soils will increase the uptake of nitrogen, phosphate, potash, sulphur, calcium, magnesium, boron, copper, zinc, and molybdenum.
4. Acts as a natural irritant to insects.
5. Increases certain herbicide effectiveness. Offsets (balances) acid from plants, Nitrogen fertilizer, rain, and harvesting.
6. Depresses acid-tolerant microbial species.
7. Supplies Calcium for "high calcium" legumes and alfalfa.

CHAPTER 2:
ORGANIC FERTILIZER PRODUCTION

The trainer will engage the farmers in identification, options and mobilisation of locally available resources applicable in organic fertilizer production.

Participants will conduct practical sessions on organic fertilizer production, with clear guidance on the type of materials, quantity and procedure.

BENEFITS OF DOING BIO-FERTILIZER AT HOME

- Low investment (ingredients & equipments)
- Easy to get ingredients (even for free)
- Common sense technology
- Possibility to combine with other land management

Bokashi Bio-fertilizer

Bokashi means precooking the organic matter on its own steam, taking advantage of heat generated by their aerobic fermentation.
Bokashi is not compost but a soil amendment product, working as inoculant. Compost takes months while Bokashi takes 15 days or even fewer.
Bokashi is made in controlled environment/conditions. It is half composed and all the microbial activities happen in the farm unlike in compost. It is an inoculant with much more soil fertility benefits than compost.

Bokashi nourishes the soil and fertilize the plant.
In Bokashi making, the temperature should go up to around 55 degrees and moisture around 50%.

There should also be aeration of the materials used; they should also not be too small to avoid compacting and not too big to avoid a slower decomposition process.
The carbon; Nitrogen ration should be around 1:25 and the PH 7 to 7.5.

Ingredients and their functions- 15 bags (of 50Kgs each) of Bokashi

i. 7 Sacks of manure (dry but fresh); a mixture of different animal manures is better.
   Manure acts as the inoculant for the microbes; it also adds minerals to Bokashi.
ii. 2 Sacks of soil, but clay can hold more minerals.
   Soil brings in the local microbes; gives local conditions. It also helps in the structure and texture. It's also a mineral carrier and giving volume to the pile
iii. 2 Sacks of rice husks; other alternatives include coffee or any cereal husks and wood shavings/chips, straw. The husks help in texture and structure. They also help in holding moisture and keep the pile aerated.

Rice husks are also rich in silicon which is also important in building the structure in soil and making all minerals go to the plant as Silicon is the only element that goes against the gravity Silicon also helps in making the plants flexible and be able to fight pests and diseases by making a layer on leaves; the plant hairs which are important in catching more sunlight are made of silicon. Silicon is one of the key elements in the middle of clay structure also helps in reducing erosion.

iv. 1 Sack of rice bran or any cereal bran (food for the microbes).
Bran is the long-term food for the microbes; rich in Vitamin B which is good for fermentation; helps in moisture absorption.

v. 1 to 2 Sacks of charcoal.
Charcoal is the house/home for the microbes; also holds minerals. It is a long term source of humus in soils as it breaks down slowly. Retains humidity and nutrients; also acts as thermal regulator for roots.
Good for root development and oxygen availability.

vi. 25kg Ashes or rock dust (mixture of the two is better); these are good sources of minerals.
This provides all trace elements; regulates PH. It also helps to hold moisture.
Mixing ash and rock dust improves minerals diversity.

vii. 10L Molasses (1L is approximately 1.4kg) or brown sugar (4kg in 10L water).
Molasses is the source of energy/food for the microbes. Also adds minerals.

viii. 500g Yeast
Acts as a starter; sets the right temperature for the microbes; it also makes food avail able for the microbes.

ix. Water (chlorine free) as required
This is the medium for the microbes to live in. too much water will push out the nitrogen leading to lost ammonia and bad smell (Water pull out Nitrogen in the pile).

Procedure

The above materials are arranged in layers in the following order starting from the bottom; -

- Rice Husks;
- Soil;
- Manure;
- Bran;
- Charcoal;
- Rock dust and
- Ash.

The layers are then watered with a solution of warm water, molasses and yeast. The same is repeated until all the materials are over. Thorough mixing is then carried out as watering continued. Thorough mixing allows air to get in. (Note: add water to the bokashi pile while mixing, do not add any more water after)

The mixing and final storage is done under shade. The final heap should be homogenous and around 1.2 m in height; higher than this will cause anaerobic condition by compaction.

The mixture is then left overnight; it starts generating heat; Mixing is done twice a day for the next 3 days during which the temperature goes up to around 50 – 55 degrees centigrade. Too hot for the hand to stay inside; temperature should not go beyond this point.

After the 3 days, the heap is then mixed once a day for the next 10 days. Mixing helps in harmonizing the temperature, aerating the materials and taking moisture out of the pile. Through the days, the pile becomes lower/smaller.

After 15 days the bokashi must be grey colour, dry and same temperature to that environment.

The best is to use Bokashi straight away, do not store it longer than 2-3 months.

AMOUNT OF BOKASHI USED IN DIFFERENT CROPS:

Crop	Amount
Seedlings development in treys-planting medium	Mix 80 part of sifted soil with 20 parts bokashi 60 part sited soil to 40 part bokashi
Fruits tree- potting soil	60 parts soil to 40 part bokashi
Leaf vegetables	50 to 80 grams per hole
Root vegetables	100 to 150 grams per hole
Vegetables that form heads	200 grams per hole
Tomatoes	125 to 250 grams
Onion or chive	25 to 50 grams
Beet root	100 grams
Lettuce	50 to 80 grams
Beans/ maize	30 to 50 grams
Brassicas	50 to 80 grams
Cucumber	50 to 80 grams

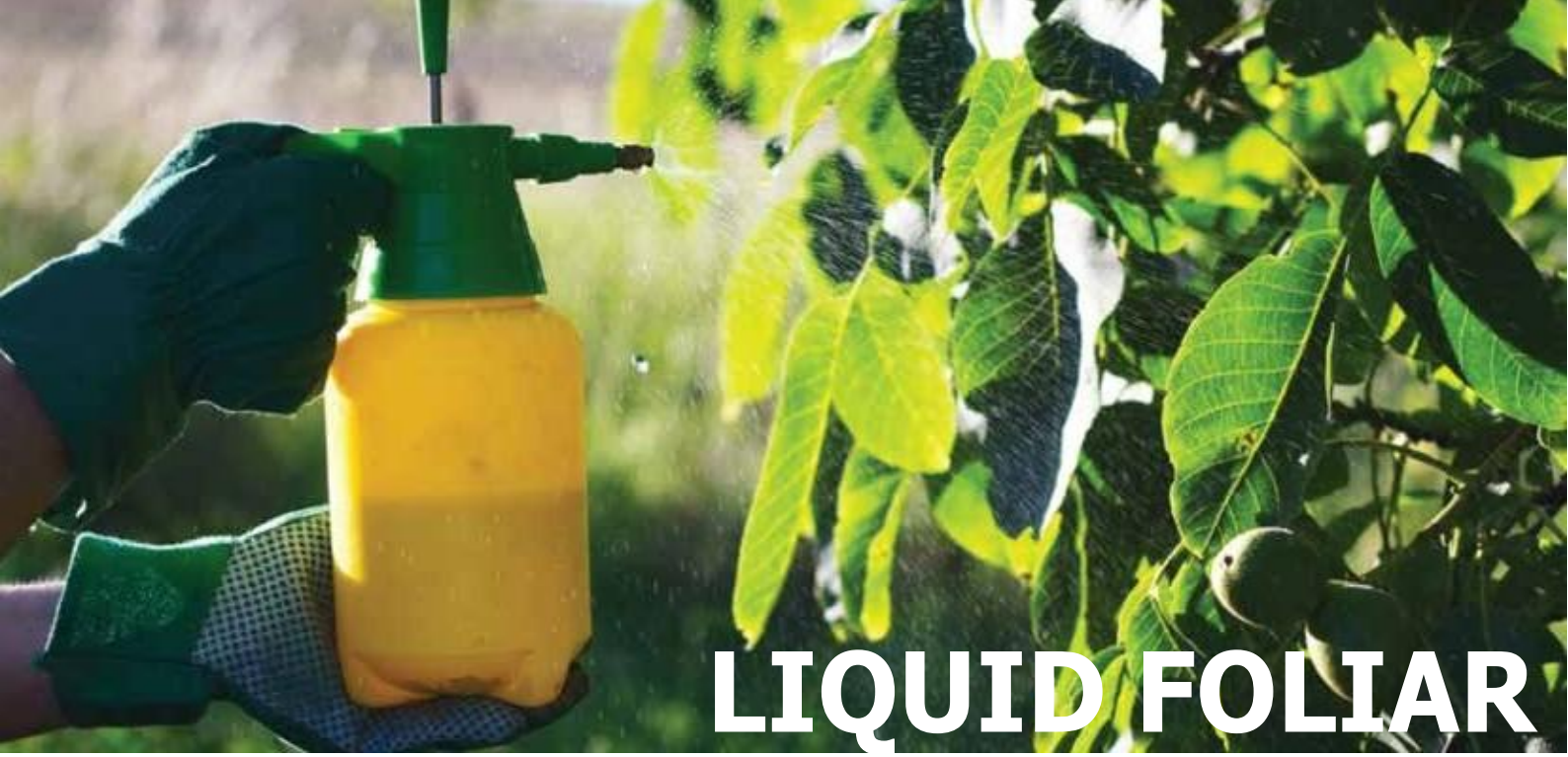
Liquid foliar Bio-Fertilizer

This is a liquid bio fertilizer made with the rumen content of cattle as the main ingredient.

The rumen content has an important bacterium known as Bacillus subtilis; it is also one of the most predominant in the soil. This is the only bacteria that can move phosphorous in the soil as this element is usually blockd.
Other action way of B. subtilis is predation of pests and diseases, keeping in balance the system.

a) Ingredients

i. 50 kg cow rumen as the inoculant
ii. 4-7 kg molasses for energy
iii. 3 l milk source of protein and lactose for making lactic fermentation happens
iv. 3 kg minerals (as more diverse source of minerals best)
You can mix: 1 kg phosphates, 1 kg rock dust and 1 kg ashes
v. 200 g yeast as the catalyst
vi. 150 l water



LIQUID FOLIAR

b) Procedure

- Put the above materials in an airtight barrel and leave it for 30 days; apply to crops that are flowering, 60 days to crops that are in developing stage or 90 days to ferment to apply to any crop.
- Apply at the rate of 3L in 100L water on first stage of growth crops, increasing the ratio up to 10 % in later growing stages i.e. flowering, fruit development or to recover plant stress after harvest in fruit trees.
- In order to enrich or fortify the fertilizer with minerals, add specific minerals after every 3 days (after the initial 4th day.
- Add the mineral required (e.g. sulphate), and then milk, molasses, and water. These will replenish the food for the microbes after scooping the required amount.

The minerals to be added should be in the following quantities:

i. Phosphite 3 kg
ii. Zinc 2 kg
iii. Calcium chloride 1 kg
iv. Magnesium sulphate 1 kg
v. Potassium sulphate 2 kg
vi. Cobalt chloride 50 g
vii. Sodium molybdate 100 g
viii. Iron sulphate 30 g
ix. Cooper sulphate 300 g
x. Borax 1 kg (boron cleans the environment in the bio-fertilizers)

When ready, the colour should be amber with an alcohol sweet smell.

Always scoop the top layer to use before stirring the ferment; most of the info on what we are interested to apply on crops is normally on top.

CHAPTER 3:
SOIL HEALTH AND NUTRIENT MANAGEMENT

The trainer will introduce the session by use of posters and illustrations on the various integrated soil fertility management practices.
The trainer will take the farmers through practical sessions to demonstrate various soil fertility management practices.

Training objectives

1. The meaning of soil management practices.
2. The different types of soil management practices.
3. The advantages and disadvantages of each of the practices.

Soil Fertility is defined as the ability of soil to provide all essential nutrients in adequate quantities and in the proper balance for the growth of plants independent of direct application of nutrients when other growth factors like light, temperature and water are favorable.

Properties of a fertile soil

- A fertile soil is rich in nutrients necessary for basic plant nutrition (including nitrogen, phosphorus, potassium, calcium, magnesium and sulphur);
- A fertile soil contains sufficient micronutrients for plant nutrition (including boron, copper, iron, zinc, manganese, chlorine and molybdenum);
- A fertile soil contains an appropriate amount of soil organic matter;
- A fertile soil has a pH in a suitable range for crop production (between 6.0 and 6.8);
- A fertile soil has a crumbly structure;
- A fertile soil is biologically active;
- A fertile soil has good water retention and supply qualities

How soil loses fertility

- Soil erosion
- Poor tillage practices
- Insufficient organic matter and mining of the soil.
- Excess use of chemical fertilizers
- Leaching.
- Overgrazing
- Poor cropping systems

Discuss with your participants the soil management practices and ask them to name some of the practices they have used.

Soil management practices are a range of strategies and techniques employed to sustainably use and improve the health, fertility, and productivity of soils.
These practices include:

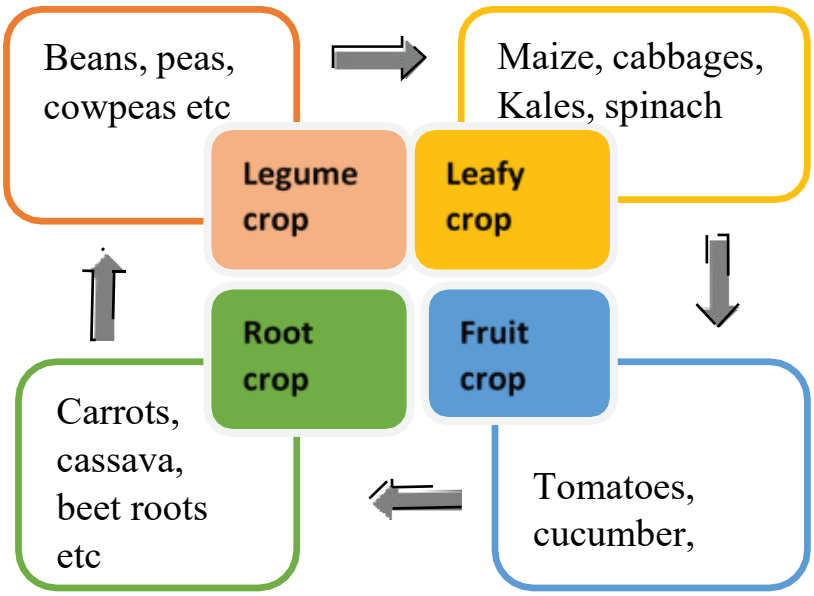
1. Crop rotation
2. Intercropping
3. Cover cropping
4. Mulching
5. Agroforestry
6. Composting,

Discuss with your participants about crop rotation and its benefits.

Crop rotation means changing the type of crops grown in the field each season or each year.
Crop rotation brings the following benefits:

1. Some have deep roots which help break the hardpans therefore improving soil structure.
2. When the leaves of some crops rot and decompose, they improve soil fertility.
3. Planting different crops breaks the life cycle of weeds, pests, and diseases and prevents them from multiplying.
4. There is the production of different types of crops.
5. It helps aerate the soil, recycles nutrients, and helps control weeds, pests, and diseases.

A sample crop rotation cycle



In crop rotation pattern, the most important consideration is the supply of plant nutrients.

- Leguminous crops: Beans and peas are said to be nitrogen-fixing because they pull nitrogen from the air and store it in their roots. So, they follow the roots and insure there'll be lots of nitrogen available for the next leaf rotation. They fix nitrogen in the soil through their root nodules and improve soil fertility e.g. beans, peas, dolichos lablab (njahi), cowpeas (thoroko), etc.
- Leafy crops (Heavy feeder) - The leaf group contains all the big nitrogen dependent crops like lettuce, greens, herbs, spinach, and the brassicas (cabbage, broccoli, cauliflower, brussel sprouts, and kale). They need lots of nitrogen to grow strong leaves and stems but nitrogen is the hardest nutrient to keep in the soil. That's why they follow the nitrogen fixing

legumes in the rotation.

- Fruit crops (Moderate feeder): The fruit crops include tomatoes, cucumbers, peppers, eggplant, and squash. These plants need phosphorus to set blossoms and develop fruit but shouldn't get lots of nitrogen or they'll make all leaves and no fruit. Technically, maize is a fruiting crop but it's exceptionally grown in the leaf group because it does need lots of nitrogen.
- Root crops - Light feeder: Onions, garlic, turnips, carrots, beets, and radishes are all root crops that need potassium but don't need much nitrogen. So, the roots follow the fruits since there's little nitrogen left at this point in the rotation.

Criteria for crop rotation

a) crop selection

What do you consider when selecting a crop for crop rotation?

1. What to produce?
2. Will it grow well?
3. What are the roots like?
4. Does it improve soil fertility?
5. Does it work with other crops?

b) choose the right variety

Choose a variety that has the characteristics you want. Make sure you get the right seed. If you find a variety that you like, consider producing your own seed to sow in the future.

1. Some varieties grow quickly and produce a yield in a short time
2. Some are taller than others or produce more leaves.
3. Some demand more or less nutrients.
4. Some are more tolerant to drought than others.
5. Some climb, while others crawl on the ground.

c) choosing a crop rotation

What crops should you plant next year, and the year after that? That depends on many factors, here are some considerations:

- Knowing the family where your crops belong helps you to decide what to plant on the next cropping season, by planting a crop that belongs to a different family to the previous one.
- Make a list of the crops you want to grow.

Advantages of crop rotation

Engage your participants in discussing the advantages of crop rotation.

1. Helps maintain and enhance soil fertility by varying the nutrient demands of different crops.
2. Rotating crops disrupts the life cycles of pests and diseases that target specific crops.
3. Crop rotation can help manage weed populations by introducing crops that are less susceptible to common weeds, reducing the need for herbicides.
4. Crop rotation can lead to increased yields by reducing soil fatigue.

Disadvantages of crop rotation

Discuss with your participants the challenges of crop rotation.

1. It is challenging to find a market for the various crops in the field.
2. Crop rotation may involve different crops maturing at different times, which can make harvest scheduling more complex.
3. Some crop rotations may require additional labor for planting, managing, and harvesting various crops, especially if they have different requirements.
4. Harvesting using machines can be difficult.

Summary

The crop rotation system breaks the crops into four groups based on their nutritional needs:

- Leaf (nitrogen),
- Fruit (phosphorus),
- Root (potassium), and
- Legume (fixes nitrogen).

In this system, the leaf plants go where legumes were last year, because legumes fix nitrogen in the soil, and leaf plants need large amounts of nitrogen. The fruits follow the leaf plants because they need phosphorus, and too much nitrogen causes them not to have fruits. The roots follow the fruits because they need potassium and need nitrogen less than the fruits. Finally, the legumes follow the roots to put

Entercropping refers to the practice of growing two or more crops in close proximity: growing two or more cash crops together, growing a cash crop with a cover crop, or other non-cash crop that provides benefits to the primary crop.

To accomplish this, four things need to be considered:

1. Spatial arrangement,
2. Plant density,
3. Maturity dates of the crops being grown
4. Plant architecture.

There are at least four basic spatial arrangements used in intercropping. Most practical systems are variations of these:

- Row intercropping — growing two or more crops at the same time with at least one crop planted in rows.

Advantages of intercropping

Discuss with your participants the advantages of intercropping.

1. Improved soil fertility through nutrient diversification.
2. Enhanced soil structure and reduced compaction.
3. Decreased soil erosion due to continuous ground cover.
4. Natural pest and disease management through crop diversity.
5. Weed suppression, reducing the need for herbicides.
6. Increased biodiversity, supporting beneficial insects.
7. Better water use efficiency with varied water requirements.
8. Diversified income from multiple crops.
9. Enhanced resilience to climate variability.
10. Alignment with sustainable agriculture principles for long-term soil health.

Disadvantages of intercropping

Discuss with your participants about the setbacks of intercropping.

1. Reduced yields due to competition for nutrients by different crops.
2. Intercropping requires more planning, monitoring, and management.
3. Harvesting multiple crops in the same field at different times can be logistically challenging and labor-intensive.
4. Marketing, and storing multiple crop types may be more complicated.
5. Not all crops are suitable for intercropping due to compatibility issues.
6. Reduced space for use of equipment.

Cover crops are plants that cover the soil and improve soil fertility.

The following characteristics make an ideal cover crop:

1. The seeds are cheap, easy to get, harvest, store, and propagate.
2. They have a rapid rate of growth and be able to cover the soil in a short time.
3. Be resistant to pests and diseases.
4. Produce large amounts of organic matter and dry material.
5. Fix nitrogen from the air and provide it to the soil.
6. Have a de-compacting root system and regenerate degraded soils.
7. Easy to sow and to manage as single crop or associated with other crops.
8. Can be used as fodder, grains as food grains.

The Example of Cowpea as a cover crop:

Cowpea (Vigna unguiculata) is an important grain legume throughout the tropics and subtrop-ics. It has some properties which make it an ideal cover crop:

- It is drought-tolerant and can grow with very little water.
- It can fix nitrogen and grows even in very poor soils.
- It is shade-tolerant and therefore compatible as an intercrop.
- It yields edible grains and can be used as animal fodder rich in protein.
- It is quite resistant to pest attacks.

Advantages of cover crops

Discuss with your participants the advantages they have experienced when using cover crops:

1. Enhance soil structure, texture, and overall health by increasing organic matter content.
2. They compete with weeds for sunlight, water, and nutrients, helping to naturally sup press weed growth.
3. Certain cover crops, especially legumes like clover, have the ability to fix atmospheric nitrogen in the soil.
4. Deep-rooted cover crops can break up compacted soil layers, improving soil structure and root penetration for cash crops.
5. Cover cropping can lead to increased crop yields and better overall farm productivity

Disadvantages of cover crops

Discuss with your participants the setbacks they have experienced when using cover crops:

1. Requires technical expertise and a substantial amount of relevant research and other preparations.
2. Requires additional costs that can burden some farmers.
3. Planting a cover crop alongside a main agricultural crop would result in competition for space, water, nutrients, and sunlight.
4. Some plants can harbor transmissible diseases or create a breeding ground for micro biomes that can damage main crops.
5. Harvesting multiple crops with different maturation times can be logistically challenging and labor-intensive.
6. There is reduced space when using machines.
7. Marketing and storing multiple crop types may be more complicated than dealing with a single crop.

Mulching refers to using dead plant material to cover the soil between crops.

1. Helps prevent soil erosion
2. Adds organic matter to the soil
3. Feeds soil life and improves soil structure
4. Adds nutrients to the soil
5. Decreases water soil due to evaporation
6. Works against weeds, in that when soil is covered in mulch, weeds do not get the light they need to grow.

Disadvantages of mulching

1. Because mulch blocks sunlight, it prevents some seeds from germinating.
2. Slugs, earwigs, cutworms, and other pests love cool, dark, moist places.
3. Heavy rains can make the ground soggy for several days.

Agroforestry is a management system that combines agriculture and trees to address conservation needs and build more profitable and weather-resilient farms, and communities.

1. Provide protection for valuable topsoil, livestock, crops, and wildlife.
2. Increase productivity of agricultural and horticultural crops.
3. Reduce inputs of energy and chemicals.
4. Increase water use efficiency of plants and animals.
5. Improve water quality and quantity.
6. Diversify local economies and on-farm income.
7. Improve air quality and sequester carbon.
8. Support working lands at the landscape scale.
9. Protects against erosion (especially on sloping lands).

Disadvantages of agroforestry

1. Delayed yield since both agricultural crops and forest trees are involved.
2. Agroforestry can facilitate unhealthy and unfavorable competition between crops and trees for resources like nutrients and water.
3. High complexity of agroforestry in terms of the presence of highly variable species and the need for these species to be integrated into a single ecosystem or habitat.
4. Agroforestry increases the risk of the spread of zoonotic diseases among humans.
5. The presence of trees among crops in agroforests can create difficulties in both n avigation and harvesting.

CHAPTER 4:
APPLICATION TECHNIQUES:

The trainer will take the farmers through practical sessions to demonstrate best practises in organic fertilizer application, farm preparation before organic fertilizer application, application levels and intervals.

The technique of fertilizer application has a significant influence on fertilizer uptake by plants. The application method varies according to the spacing of crop, type of fertilizer material, time of application.

When fertilizer is applied by hand, extreme care should be taken to distribute nutrients uniformly and at the exact rates. Where fertilizer application equipment is used, it should be adjusted to ensure uniform spreading and correct rates. The equipment should be well maintained.

Fertilizers are applied by different methods mainly for 3 purposes:

1) To make the nutrients easily available to crops,
2) To reduce fertilizer losses and
3) For ease of application.

The aspects that require consideration in fertilizer application are listed below:

1) Availability of nutrients in manures and fertilizers.
2) Nutrient requirements of crops at different stages of crop growth.
3) Time of application.
4) Methods of application, placement of fertilizers.
5) Foliar application.
6) Crop response to fertilizers application and interaction of N, P, and K.
7) Residual effect of manures and fertilizers.
8) Unit cost of nutrients and economics of manuring.

The time and method of fertilizer application vary in relation to

1) The nature of fertilizer.
2) Soil type and differences in nutrient requirement and nature of field crops.

Methods of Fertilizer Application

1. Application of fertilizers in solid form
It includes the methods like:

1.1. Broadcasting

Even and uniform spreading of manure or fertilizers by hand over the entire surface of field while cultivation or after the seed is sown in standing crop, termed as broad casting.

It is suitable for crops with dense stand, the plant roots permeate the whole volume of the soil, large doses of fertilizers are applied and insoluble phosphatic fertilizers such as rock phosphate are used.

Depending upon the time of fertilizer application, there are two types of broadcasting:

a) Broadcasting at planting or basal application and
b) Top dressing.

a) Broadcasting at planting

Broadcasting of manure and fertilizers is done at planting or sowing of the crops with the following objectives:

- To distribute the fertilizer evenly and to incorporate it with part of, or throughout the plough layer and
- To apply larger quantities that can be safely applied at the time of planting/sowing with a seed-cum-fertilizer driller.

b) Top dressing

Spreading or broadcasting of fertilizers in the standing crop (after emergence of crop) is known as top-dressing. Generally, NO_3– N fertilizers are top dressed to the closely spaced crops like wheat, paddy. e.g. sodium nitrate, ammonium nitrate and urea, so as to supply N in readily available from the growing plants. The term side dressing refers to the fertilizer placed beside the rows of a crop (widely spaced) like maize or cotton. Care must be taken in top dressing that the fertilizer is not applied when the leaves are wet or it may burn or scorch the leaves. The top dressing of P and K is ordinarily done only on pasture lands which occupy the land for several years.

1.2. Placement

- It refers to the placement of fertilizers in soil at a specific place with or without reference to the position of the seed.
- Placement of fertilizers is normally recommended when the quantity of fertilizers to apply is small, development of the root system is poor, soil have a low level of fertility and to apply phosphatic and potashic fertilizer.

a. Plough sole placement

- In this method, fertilizer is placed at the bottom of the plough furrow in a continuous band during the process of ploughing.
- Every band is covered as the next furrow is turned.
- This method is suitable for areas where soil becomes quite dry up to few cm below the soil surface and soils having a heavy clay pan just below the plough sole layer.

By this method, fertilizer is placed in moist soil where it can become more available to growing plants during dry seasons. It results in less fixation of P & K than that which occurs normally when fertilizers are broadcast over the entire soil surface.

b. Deep placement or sub-surface placement

In this method, fertilizers like ammonium sulphate and urea, is placed in the reduction zone as in paddy fields, where it remains in ammonia form and is available to the crop during the active vegetative period. It ensures better distribution in the root zone and prevents any loss by surface runoff.

c) Localized placement or spot application

It refers to the application of fertilizers into the soil close to the seed or plant. It is usually employed when relatively small quantities of fertilizers are to be applied.

Advantages:

- The roots of the young plant are assured of an adequate supply of nutrients,
- Promotes a rapid early growth,
- Make early intercultivation possible for better weed control,
- Reduces fixation of phosphorus and potassium.

Localized placement or spot application includes different methods like (i) contact placement or combined drilling or drill placement, (ii) band placement, (iii) pellet application, (iv) side dressing, (v) circular placement, (vi) pocket placement, (vii) pellet application.

i. Contact placement or combined drilling or drill placement

It refers to the drilling of seed and fertilizer together while sowing. It places the seed and small quantities of fertilizers in the same row. This is found useful in cereal crops, cotton and grasses but not for pulses and legumes. This may affect the germination of the seed, particularly in legumes due to excessive concentration of soluble salts.

ii. Band placement

In this, fertilizer is placed in bands which may be continuous or discontinuous to the side of seedling, some distances away from it and either at level with the seed, above the seed level or below the seed level. There are two types of band placement: It includes hill and row placement.

- **Hill placement:** When the plants are spaced 3 ft. or more on both sides, fertilizers are placed close to the plant in bands on one or both sides of the plants. The length and depth of the band and its distance from plant varies with the crop and the amount of fertilizer as in cotton.
- **Row placement:** When the seeds or plants are sown close together in a row, the fertilizer is put in continuous band on one or both sides of the one or both sides of the row by hand or a seed drill. It is practiced for sugarcane, potato, maize, tobacco, cereals and vegetable crops.

Higher rates of fertilizers are possible with row placement than hill placement. For applying small amount of fertilizers, hill placement is usually most effective.

iii. Pellet application

In this method, fertilizer (nitrogenous fertilizers) is applied in the form of pellets 2.5 – 5.0 cm. deep between the rows of paddy crop. Fertilizer is mixed with soil in the ratio of 1:10 and make into dough. Small pellets of a convenient size are then made and deposited in the soft mud of paddy fields. It increases the efficiency of nitrogenous fertilizers.

iv. Side dressing

Fertilizers are spread in between the rows or around the plants. It includes

i) application of nitrogenous fertilizers in between the rows by hand to broad row. crops like maize, S.cane tobacco,cereals which is done to supply additional doses of N to the growing crop.

ii) Application of mixed or straight fertilizer around the base of the fruit trees and done once, twice or thrice in a year depending upon age.

v. Circular placement

Application of manures and fertilizers around the hill or the trunk of fruit tree crops in the active root zone.

vi. Pocket placement

Application of fertilizers deep in soil to increase its efficiency Especially for the sugarcane pocket placement is done. Fertilizers are put in 2 to 3 pockets opened around every hill by means of a sharp stick.

Generally, placement of fertilizer is done for three reasons.

- Efficient use of plant nutrients from plant emergence to maturity.
- To avoid the fixation of phosphate in acid soils.
- Convenience to the grower.

Advantages of placement of fertilizers

The main advantages are as follows:

- When the fertilizer is placed, there is minimum contact between the soil and the fertilizer, and thus fixation of nutrients is greatly reduced.
- The weeds all over the field cannot make use of the fertilizers.
- Residual response of fertilizers is usually higher.
- Utilization of fertilizers by the plants is higher.
- Loss of nitrogen by leaching is reduced.
- Being immobile, phosphates are better utilized when placed.

2. Application of fertilizers in liquid form

2.1. Starter solutions

It refers to the application of solution of N, P_2O_5 and K_2O in the ratio of 1:2:1 and 1:1:2 to young plants at the time of transplanting, particularly for vegetables.

- Starter solution helps in rapid establishment and quick growth of seedlings.

2.2. Foliar Application

a. It refers to the spraying of fertilizer solutions containing one or more nutrients on the foliage of growing plants.
b. Several nutrient elements are readily absorbed by leaves when they are dissolved in water and sprayed on them.
c. The concentration of the spray solution has to be controlled, otherwise serious damage may result due to scorching of the leaves.
d. Foliar application is effective for the application of minor nutrients like iron, copper, boron, zinc and manganese. Sometimes insecticides are also applied along with fertilizers.

2.3. Application through irrigation water (Fertigation)

- It refers to the application of water soluble fertilizers through irrigation water.
- The nutrients are thus carried into the soil in solution.
- Generally nitrogenous fertilizers are applied through irrigation water.

CHAPTER 5:
ENVIRONMENTAL CONSIDERATIONS

The trainer will engage participants in learning sessions on the environmental considerations, benefits in use of organic fertilizers for sustainable farming methods.

Farmers need to be prepared and since the soil is one of the most important ingredients for farmers it is wise to work on the soil, with this climate change constantly in mind. Making your soil climate change-proof, with minimal or no use of chemical fertilizers, is one of the purposes of this module.
Environmental consideration is important aspect in application of organic fertilizers and mitigating the effects of climate change.

It is also important to Understand climate-smart soil preparation techniques, including conservation tillage, mulching, cover cropping, agroforestry, and crop rotation, that can help mitigate climate impacts and improve soil health.

Make this a discussion among the participants, let them share their thoughts about the shifts in weather patterns and how it has affected their planting seasons.

Climate change refers to long-term shifts in temperatures and weather patterns. Such shifts can be natural, due to changes in the sun's activity or large volcanic eruptions.

Climate-smart soil preparation techniques are agricultural practices designed to enhance soil health, improve resilience to climate change, and increase agricultural productivity while minimizing greenhouse gas emissions. These techniques aim to address the challenges posed by a changing climate, such as extreme weather events, altered precipitation patterns, and shifting temperature regimes.

Key elements of the climate-smart soil preparation techniques

Here are some key elements of the climate-smart soil preparation techniques (some have already been mentioned in the previous topics):

1. Conservation Tillage: Conservation tillage practices, such as no-till or reduced tillage, minimize soil disturbance by leaving crop residues on the field's surface. This helps protect against soil erosion, maintain soil structure, and increase organic matter content.

2. Cover Cropping: Planting cover crops during fallow periods or between main crops helps improve soil health.

3. Integrated Nutrient Management (INM): INM integrates both organic and inorganic sources of nutrients, taking into consideration the specific nutrient requirements of crops, soil characteristics, and local conditions, such as balanced nutrient application of organic or inorganic fertilizers.

4. Agroforestry and Tree Planting: Integrating productive trees and shrubs into agricultural landscapes through agroforestry practices not only sequesters carbon but also provides shade, windbreaks, and additional sources of income through timber and fruit production.

5. Water Management: Effective water management practices, such as rainwater harvesting, irrigation scheduling, and efficient water use, are crucial for mitigating the impacts of climate change, including droughts and irregular precipitation.

6. Soil Organic Matter Enhancement: Strategies to increase soil organic matter, such as incorporating organic materials (compost, crop residues) into the soil, promote improved soil structure, nutrient retention, and water-holding capacity.

7. Conservation of Biodiversity: Maintaining biodiversity within and around agricultural fields supports pollinators, natural pest control, and soil microorganisms, contributing to a more resilient ecosystem.

8. Soil Testing and Monitoring: Regular soil testing and monitoring help farmers make informed decisions about nutrient application, irrigation, and other practices tailored to their specific soil and climate conditions and the right choice of crops for the soil.

9. Knowledge Sharing and Training: Knowledge sharing helps ensure that sustainable practices are adopted and adapted to local contexts.

10. Charcoal or Biochar Application: Incorporating biochar (charcoal produced from organic materials) into the soil improves soil fertility, increases carbon sequestration, and enhances soil moisture retention.

11. Soil Carbon Sequestration: This involves implementing practices that enhance soil organic carbon content, such as adding organic matter, which can help absorb carbon dioxide from the atmosphere, mitigating climate change. Carbon is found in all living organisms and is the major building block for life on earth. Carbon exists in many forms, predominantly as plant biomass, soil organic matter, and as the gas carbon dioxide (CO2) in the atmosphere and dissolved in seawater. Carbon sequestration is the long-term storage of carbon in oceans, soils, vegetation (especially forests), and geologic formations. Although oceans store most of the earth's carbon, soils contain approximately 75% of the carbon pool on land — three times more than the amount stored in living plants and animals. Therefore, soils play a major role in maintaining a balanced global carbon cycle.

CHAPTER 6:
FARM INTEGRATION:

The trainer will share best practises in integration of organic fertilizers in the farming system for improved yields and sustainability. This will include various forms of farm practices that contribute to production of organic fertilizers- such as organic matter and compost making, crop rotation for conserving moisture and plant nutrients.

Organic matter refers to any material that contains carbon compounds, derived from living organisms or their remains.

Organic matter can take many forms, including:

1. Plants and plant residues
2. Animal remains
3. Micro-organisms
4. Manure and Compost

Basis should be a small-holder mixed farming system. The integration of organic fertilizer to the farm would include:

- Using crop residues, manure, other agricultural by-products as source-material for organic fertilizer production and input. (circular approach)
- Reducing the usage of inorganic fertilizer by using organic fertilizer (also, complementary use)
- Long term interest of farmers to keep the soil healthy keeps their production up
- Teasering Black Soldier Fly production to turn green waste into animal protein that can be used as animal feed

CHAPTER 6:
REGULATORY COMPLIANCE:

The trainer will take the farmers through regulatory compliance in regard to local regulations and certification related to organic farming methods- Organic standards and certification, Participatory Guarantee system (PGS)

Organic certification is a process by which an independent party gives a written assurance that the production/ processing systems are in conformity with organic standards. This allows accessing good organic markets while addressing hunger, malnutrition and related challenges as water use, climate change and unsustainable food production and consumption. This is because organic agriculture is a holistic production based on sustainable ecosystems, safe food, good nutrition, animal welfare and social justice.

Organic certification ensures that the inputs used in organic farming, such as fertilizers, pesticides, and other agricultural products, meet specific standards and criteria set by organic certification bodies. The criteria for farm input approval vary slightly between different certification bodies and countries, but generally, the following principles and criteria are considered:

1. Prohibition of synthetic chemicals: Organic farming emphasizes the use of natural and organic inputs, while strictly prohibiting the use of synthetic chemicals, including synthetic fertilizers, pesticides, and genetically modified organisms (GMOs). Farm inputs seeking organic certification must meet these criteria and should not contain any synthetic or prohibited substances.
2. Natural and sustainable sourcing: Organic farm inputs should be derived from natural and sustainable sources. For example, organic fertilizers may include compost, manure, bone meal, or plant-based materials. Pesticides may include naturally occurring substances like neem oil or beneficial insects for pest control. The inputs should be obtained in an environmentally responsible and sustainable manner.
3. Non-toxic and environmentally friendly: Organic farm inputs should not cause harm to human health or the environment. They should be non-toxic and free from contaminants, residues, or heavy metals that could potentially pollute the soil, water, or air.
4. Transparency and traceability: The organic certification process requires transparency and traceability of farm inputs. Manufacturers and suppliers of organic inputs need to provide detailed information about the composition, sourcing, and processing methods used for their products. This information allows certification bodies to assess the compliance of the inputs

with organic standards.

5. Compliance with organic regulations: Farm inputs seeking organic certification must comply with the specific organic regulations and standards set by the certification body or the governing organic agriculture organization in a particular country or region. These regulations may include specific requirements for labeling, documentation, and handling of organic inputs.

Certification bodies responsible for organic input approval typically conduct inspections, audits, and lab testing to ensure that the farm inputs meet the defined criteria. They may also require ongoing monitoring and re-evaluation of the inputs to maintain their organic certification status.

It's important to note that the specific criteria for farm input approval may vary depending on the organic certification program or country in which the certification is sought. It is advisable for farmers and manufacturers to consult the specific guidelines provided by the relevant certification body to ensure compliance with the organic standards in their region.

There are various organic standards on the private, national, regional, and international level.

The aims of organic standards are:

- To protect consumers of organic products against fraud in the markets.
- To protect producers against fake input suppliers.
- Give assurance that all processes in organic production, handling, up to marketing are screened and inspected to comply with set standards.
- Provide harmony for production, certification, identification and labeling of organically grown produce.
- To provide international guidelines for organic food control systems to facilitate recognition of national systems as equivalent for the purposes of imports and exports.
- To maintain and enhance organic agricultural systems in each country contribute to local and global preservation.

Types of organic certification

Third-party certification

Third-party certification is whereby the farm, or the business is certified by an accredited organic certification agency guided by national or international standards. To acquire this certification, the farmer, or the processor is required to undertake the following:

- Ensure that he/ she has adequate knowledge on the organic practices / standards, on what is allowed or not allowed in the practice of organic farming by studying the available resources on organic farming.

- Work to ensure that the production methods including all farm inputs, sources and suppliers follow the organic standards.
- Keeping records of the history of the farm and current farm activities especially results of tests done soil and water.
- Production/ processing plans- in case of a farmer, there should be a clear record of how the production process is intended to be done. (Where the seeds are to be obtained from, how the soil fertility is to be enhanced, pest control methods to be applied, how the yields are to be harvested and stored.
- Random and planned inspections and tests on soil and water are to be done to ensure that the planned approaches are being followed, and that the records are kept consistently.

If the farmer, is transitioning from conventional to organic farming, the farm must have been free of prohibited substances for 2-3 years. During this period of transition, the produce is not considered fully organic.

For other operations other than farming, the main areas of focus will be on the quality of ingredients, if in processing, and the conditions of processing, packaging, and transport.

Participatory Guarantee Systems (PGS)

Nowadays smallholder farmers can be certified under PGS (participatory guarantee system) which is an alternative for the third-party certification.
In PGS, farmers, consumers and stakeholders of the groups undergoing the process participate directly in choosing the standards of the processes, developing, and implementing the certification procedures and decisions.

PGS certify group producers based on their active participation and it is built on trust social networks and exchange of knowledge. It is done in groups and all participants must come from the same locality. If one member falls short of the set standards, in the process, the whole group loses credibility and cannot be certified. It is important to note that the certificate is renewed annually.

Organic Certification Bodies in Kenya

Kenya, Uganda, and Tanzania were joined together to harmonize the existing organic standards into one as East Africa Organic Products Standard which was launched in 2005 and 2006. Under this umbrella, there are existing bodies that provide certification services in Kenya and other East African countries

Contacts

1. Encert Organic (Kenyan certification body that offers organic certification services to individual producers as well as producer groups.) TEL: +254-724-910-240. E-mail: info@encert.co.ke
2. AfriCert (leader in Agribusiness certification, doing certification for vegetables, fruits and commodity products such as coffee, cocoa, tea and cut flowers) - Nairobi, Mombasa road. TEL: +254-715-041-339. Email: organic-cert@africertlimited.co.ke
3. KOAN (Kenya Organic Agriculture Network - a national membership organization for organic agriculture in Kenya.) TEL:+254-728-772-805/ +254-731-772-805. Email: info@koan.co.ke
4. The Kenya Certifiers -0727 977 009
5. Control Union- 0702 618 885.
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